TABLE 1.—STOMACH CONTENTS OF 15 VARANUS BREVICAUDA; 6 OF THE 15 STOMACHS WERE EMPTY. VOLUMES MEASURED IN CC.

FOOD ITEM	NUMBER	VOLUME	FREQUENCY
Grasshoppers	4	2.1	26.7
Roaches	1	0.1	6.7
Beetles	1	0.5	6.7
Reptile Eggs	2	2.0	6.7
Caterpillars	2	0.3	6.7
Isopods (?)	2	0.1	6.7
Unidentified Insects	1	0.2	6.7
TOTALS	13	5.3	

activity. Of the 7 males dissected, the largest testes occur during August. One female contained two large oviducal eggs; unfortunately there is no date of collection with this specimen.

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DISTRIBUTION AND VARIATION OF THE SOUTHERN EMU-WREN IN WESTERN AUSTRALIA

By JULIAN FORD, Lynwood

INTRODUCTION

The subspecies status, relationships and distribution of several of the bird-isolates in South-western Australia have not been adequately determined. This must be completed before a proper zoogeographical study can be undertaken. The present paper is one of a series by the author on the distribution, geographic variation, taxonomy and evolution of Western Australian birds.

DISTRIBUTION

In Western Australia the Southern Emu-Wren, *Stipiturus malachurus,* is an inhabitant of the south-west, north to Dirk Hartog Island and east to Israelite Bay, but avoids the heavy jarrah-karri-wandoo forest block except for a few minor penetrations (Ford, 1965). Being a rather secretive and unobtrusive inhabitant of low scrub formations, it is easily overlooked but appears to have a continuous coastal distribution and a patchy inland distribution. Its in and occurrences depend on suitable low heath on sandplains and ironstone-gravel hills.

Serventy and Whittell (1967) have suggested that there is a break in distribution on the south coast between Hopetoun and Mississippi Bay (east of Esperance), coinciding with a rain

shadow and rainfall decrease. In view of some inland observations I have reeently made, this seems unlikely.

On February 7, 1966, I collected a male speeimen (of the form *medius)*, 35 miles south-east of Mt. Holland, along a traek between Norseman and Hyden. The bird was in an extensive belt of sandplain country vegetated predominantly with dense *Casuarina corniculata* and other low bushes up to three feet in height. The specimen is extraordinary in that the tail is slightly over six inches long. Because the record constitutes a considerable range extension inland to an area where the average rainfall is about ten inehes, its absence from the relatively higher rainfall belt between Hopetoun and Esperance seems improbable.

I have also seen the Southern Emu-Wren at Ravensthorpe, about 30 miles north of Hopetoun. On January 25, 1966, two parties were seen in low heath scrub consisting of *Melaleuca uncinata, Kunzea affinis, Hakea verrucosa, Grevillea platypoda, Dodonaea pinifolia* and *Platysace maxwelli* on a gravelstone hill. The Southern Emu-Wren is eommon in low sandplain heath in the Cape Le Grand area between Esperance and Mississippi Bay.

It is interesting to note that although Condon (1962) does not inelude Eyre Peninsula in the range of *Stipiturus malachurus*, an emu-wren has been reported as occurring in cutting grass and dwarf tea tree flats around Wanilla by Storr (1947) and Terrill and Rix (1950). Storr (1948) later withdrew his identification of it as *malaehurus* beeause he did not collect a speeimen, but the geographieal location and habitat suggest that the speeies can only be *malaehurus*. Since isolated populations of this species have undergone subspeeiation, it is probable that Eyre Peninsula birds belong to an undescribed subspecies. South Australian ornithologists should therefore endeavour to collect specimens.

VARIATION AND SUBSPECIES

The subspecies of *Stipiturus malachurus* have been reviewed by Condon (1951), Keast (1957), and Serventy and Whittell (1967). Three subspecies are currently recognised in Western Australia:

1. *Stipiturus malaehurus westernensis*. Campbell 1912. This has coarse dark streaks on the head (extending right down to the bill) and back. The chestnut coloration on the head, flanks and baek is darker than in the other two forms.

TABLE 1.—MEASUREMENTS OF STIPITURUS MALACHURUS

	MALES				FEMALES			
Subspecies	No.	Mean	Range	S.D.	No.	Mean	Range	S.D.
BILL								
westernensis	8	12.0	11-12.5	0.5	7	11.9	11.5-12.5	0.4
medius	4	11.5	11-12	0.4	3	11.5	11-12	
hartogi	1		11					
intermedius	9	12.1	11.5-12.5	0.3	7	12.0	11.5-12.5	0.3
halmaturinus	1		13		2	12.5	12.5,12.5	
TARSUS								
westernensis	10	19.9	19-21	0.8	8	19.3	19-20	0.4
medius	4	19.4	19-20	0.6	3	18.8	18.5-19	
hartogi	1		19		1		18	
intermedius	9	19.2	18-19.5	0.5	7	18.8	18-19.5	0.5
halmaturinus	1		20.5		3	19.7	19-20	
WING								
westernensis	10	43.8	41.5-45.5	1.2	8	42.6	40-44	1.6
medius	4	43.1	40.5-45	1.9	3	42 5	42-43	
hartogi	1		38.5		2	37.0	37.37	
intermedius	9	43.9	42-45	1.2	8	42.3	41-43.5	0.9
halmaturinus	1		44		3	45.3	44.5-46	

All measurements to nearest 0.5 mm. Bill measured to base of skull.

The range is along the extreme south-west coastal strip, east to about Albany and north to about Perth.

2. *Stipiturus malachurus medius.* Mathews 1919. The chestnut coloration is paler on the back, edges of wing feathers, abdomen and flanks. The streaks on the dorsal surface are narrower and paler, and the throat is possibly a paler shade of blue. The margins of the feathers on the head and back are greyer.

This form is distributed north and east of Guilderton (at the mouth of the Moore River), the heavy forest block, Tambellup and Cheyne Beach.

3. *Stipiturus malachurus hartogi.* Carter 1916. This is a small form which is generally paler and greyer than the above race. The streaks on the head and back are considerably narrower and almost absent.

It is only known from Dirk Hartog Island but probably also occurs on Edel Land and the coastal strip southwards.

There are two clines in South-western Australia, *viz.* a south-north cline of decreasing size (see Table 1) and a radial cline in the intensity of plumage pigmentation. The darkest birds are in the Cape Leeuwin area, and the palest and smallest, on Dirk Hartog Island. Gene flow between *westernensis* and *medius* is precluded o some extent by their partial isolation due to the heavy forest block which is unoccupied by the species.

DISCUSSION

It should be stressed that the morphological differences between the various isolates of *Stipiturus malachurus* are not great. Indeed *intermedius* of the Mt. Compass area, South Australia, and *halmaturinus* of Kangaroo Island are almost indistinguishable from some *westernensis* x *medius* intermediates except, perhaps, that the South Australian birds usually have a plain forehead (instead of the streaks reaching the bill) and less chestnut on the back of the crown.

In view of the differences between the two south-western mainland subspecies being due to clinal trends with no steps, there is a strong case for the application of only one subspecific name for the entire mainland isolate. The recognition of a single name would certainly be advantageous in zoogeographical discussions. The population on Dirk Hartog Island should be considered a separate subspecies *(hartogi)* until the population on the adjacent mainland, if one occurs there, is shown to be identical.

Despite arguments to the contrary there are good grounds for regarding *Stipiturus malachurus, S. ruficeps* and *S. mallee* as conspecific. *S. mallee* of the Victorian mallee-spinifex area bridges the morphological gap between the other two though it is more like *ruficeps* and any similarity to *malachurus* may be due to convergence. I follow recent reviewers (Keast, 1957; Condon, 1962) and consider the forms *malachurus* and *ruficeps* as separate species (and, therefore, members of a superspecies) but categorise *mallee* as a subspecies of *ruficeps.*

Keast could be correct is his hypothesis that *mallee* is an eastern outlier of a mallee-adapted stock derived from the south-western part of the continent. Other forms in the Victorian mallee which are derivatives of western species are *Psophodes nigrogularis leucogaster* and *Manorhina [flavigula] melanotis;* while there are several subspecies (for example *Microeca leucophaea assimilis, Neositta chrysoptera pileata, Pachycephala pectoralis fuliginosa, Melithreptus brevirostris leucogenys* etc.,) with

an expanded range from South-western Australia—where they were formerly isolated—to as far as the Victorian Mallee.

The only drawback in Keast's hypothesis is that it does not explain how the western *Stipiturus malachurus* population avoided interbreeding with other populations (on Eyre Peninsula and south-eastern South Australia) during the pluvial period which allowed secondary range expansions including the eastward movement of the western population. It is almost certain that the present isolates in the South-West, on Eyre Peninsula and in south-eastern South Australia are all genetically compatible with each other and with the parental eastern form. *S. ruficeps* occurs in the mallee-spinifex belt north of the Nullarbor Plain (Collins, 1943; Ford and Sedgwick, 1967) and not *S. malachurus medius* as might be expected from Keast's hypothesis.

There are good reasons for believing that *S. mallee* is derived from *S. ruficeps*. The colour pattern on the head and the disposition of blue leads to this conclusion (cf. Serventy and Whittell 1967). The distribution pattern in *ruficeps* and *mallee* is similar to that in *Amytornis striatus* which is mainly distributed in the mid-western part of the continent but has a distinct form (the nominate subspecies) in the drier parts of south-eastern Australia including the Victorian mallee-spinifex sandplain belt (Keast, 1958). In *Stipiturus* and *Amytornis striatus* the gibber plains of the Lake Eyre Basin operate as a distribution barrier. It appears that *mallee* should be treated as a subspecies of *ruficeps*.

The habitat of *mallee, viz.* low bushes and *Triodia* clumps in mallee sandplain, is virtually identical with the habitat of *ruficeps*. The presence of mallee-eucalypts in the area of occurence of *mallee* is incidental to its actual habitat. Climatically, the area occupied by *mallee* is similar to that occupied by *hartogi* and inland *medius*.

The trend in *hartogi* towards reduction and loss of dorsal streaks, particularly on the crown, suggests that *ruficeps* may have budded off from a south-western ancestor.

SPECIMENS EXAMINED

WESTERN AUSTRALIA: Kundip (1); Mt. Barren area (1); Mt. Holland area (1); Lancelin (2); Tambellup (2); Augusta (1); Busselton (2); Margaret River (1); Denmark (1); Torbay (1); Albany (7); Ellensbrook (1); Two People Bay (2); Redmond (1); Nannup (1); Dirk Hartog Island (3).

SOUTH AUSTRALIA: Mt. Compass (13); Square Waterhole (3); Second Valley (1); Stokes Bay, Kangaroo Island (6); Flinders Chase, Kangaroo Island (1).

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SUMMARY

Geographic variation in Stipiturus malachurus (Shaw 1798) in Western Australia is discussed. The western isolate is divided into races westernensis, medius and hartogi. New information on distribution and habitat is given including its occurrence in sandplain near Mt. Holland.

FIELD AND STUDY

Predation of the Scorpion, *Urodacus hoplurus*, by the Lizard, *Varanus gouldi*.- *Urodacus hoplurus* Pocock, 1898, family Scorpionidae), one of the larger members of the Australian scorpion genus *Urodacus*, lives in the soil in burrows 8-16 inches deep, and seems to be widespread throughout the central, more arid parts of the Australian continent. On January 30, 1968, at noon, Mr A. M. Douglas and I observed a large lizard digging at a scorpion burrow 4 miles S. of Yalgoo (Lat 28°20'S, Long. 116°41'E). There were many burrows of *U. hoplurus* all over the area. The lizard was shot and its stomach contents were found to include two male and two female specimens of *U. hoplurus*. The anterior ends of the scorpions had been bitten but not severed from the bodies; one of the females was practically undamaged.

The scorpions seemed to have been recently ingested, a view supported by Dr G. M. Storr who identified the lizard as *Varanus gouldi* Gray, 1838, and added that these lizards feed during the daytime. The lizard (W.A.M. Registration No. R 30912) and the scorpions (Nos. 68-889 to 68-892) have been lodged in the Western Australian Museum. The figure shows (1) a burrow entrance of this species of scorpion, (2) the result of the digging up of a scorpion burrow by the lizard near where it was collected, and (3) the lizard with the scorpions from its stomach.

The stomach contents of the lizard also included a few pieces of ground-beetle, family Carabidae. The number of species of ground-beetle could not be ascertained with certainty, but one species of the genus *Philoscaphus* was present. While collecting specimens from burrows, I have dug some species of Carabidae out of their burrows in various parts of Western Australia. It is suggested that these lizards, *V. gouldi*, actively dig out and eat carabs as well as scorpions.